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DESCRIPTION

DRUM WASHING MACHINE

TECHNICAL FIELD

This invention relates to a drum washing machine with a
5 rotating tub rotated about a transverse axis.

BACKGROUND ART

A drum washing machine includes a rotating tub rotated about
a transverse or substantially horizontal axis and a water tub
accommodating the rotating tub. The rotating tub has an inner
10 peripheral wall provided with a plurality of baffles raising
laundry. In each of wash and rinse steps, water is reserved in
the water tub and the rotating tub accommodating laundry is
rotated at low speeds. As a result, the laundry in the rotating
tub is raised and then falls down repeatedly, whereby the laundry
15 is washed by a beat-wash manner. In a dehydration step, the
rotating tub is rotated at low speeds so that water contained
in the laundry is removed to some extent and thereafter, the
rotational speed of the rotating tub is gradually increased up
to a maximum speed so that the laundry is centrifugally
20 dehydrated.

When laundry is put into the rotating tub to be one-sided
such that the laundry is one-sided in the rotating tub at the
time of start of washing operation, the one-sided state of laundry
cannot be solved even after a washing step progresses. A great
25 vibration is produced in the dehydration step when laundry is
one-sided particularly near both axial ends in the interior of
the rotating tub. In the conventional drum washing machines,
accordingly, a liquid balancer is provided to restrain

production of great vibration or noise due to an unbalanced state of laundry or the rotating tub is rotated in the normal and reverse directions at low speeds in an initial stage of the dehydration step so that the unbalanced state is corrected. However, even
5 when the aforementioned method is adopted, vibration or noise cannot sufficiently be suppressed in large types of drum washing machines with large washing capacity.

JP-A-2002-31598 proposes a construction in which auxiliary baffles are provided on a rear end plate of the rotating tub in
10 a drum washing machine with a rotating tub inclined frontward upward in order that reduction in the cleaning performance due to the unbalanced state of laundry may be restrained. Laundry tends to be easily one-sided to an inner interior of the rotating tub when the rotating tub is inclined frontward upward.
15 According to the foregoing construction, the laundry one-sided in the inner interior of the rotating tub is sufficiently agitated, washing unevenness can be restrained.

Patent document: JP-A-2002-31598

DISCLOSURE OF THE INVENTION

20 PROBLEM TO BE OVERCOME BY THE INVENTION

However, the aforementioned auxiliary baffles are provided for the purpose of agitating laundry which is located at the inner interior of the rotating tub and cannot be agitated by the conventional baffles. That is, even when the auxiliary baffles
25 are provided, the washing operation is continued while the problem of laundry being one-sided to the inner interior of the rotating tub remains unsolved. As a result, large vibration or noise tends to occur easily in the dehydration step.

Therefore, an object of the present invention is to provide a drum washing machine which can suppress occurrence of vibration or noise in the dehydration step.

MEANS FOR OVERCOMING THE PROBLEM

5 The present invention provides a drum washing machine comprising a water tub, a rotating tub provided in the water tub to be rotated about a transverse axis, elastic supporting means for elastically supporting the water tub, and an auxiliary baffle provided on an inner peripheral wall of the rotating tub so as
10 to be close to one of both axial end plates of the rotating tub and spaced away from the other end plate of the rotating tub, the auxiliary baffle extending in a direction of axis of the rotating tub, characterized in that the auxiliary baffle moves laundry in the rotating tub near a center of gravity of a member
15 of vibration system applying load to the elastic supporting means.

In the above-described construction, the auxiliary baffle has an inclined face inclined at the inner peripheral wall side from one end plate side of the rotating tub to the other end plate
20 side.

EFFECT OF THE INVENTION

Upon rotation of the rotating tub in a washing operation, laundry located both axial ends of the rotating tub is moved to a central interior of the rotating tub by the action of the
25 auxiliary baffle. Consequently, since unbalance is prevented from occurring at both axial ends of the rotating tub during the dehydrating step, occurrence of large vibration can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a drum washing machine in accordance with one embodiment of the present invention;

FIG. 2 is a longitudinal side section of the drum washing machine;

FIG. 3 is a perspective view of a rotating tub with a drum lid being eliminated;

FIG. 4 is an enlarged perspective view of an auxiliary baffle;

FIG. 5 is a view explaining the difference between a centrifugal force applied to laundry located at an outer peripheral position and a centrifugal force applied to laundry located at an inner peripheral position in the rotating tub;

FIG. 6 is a view explaining a centrifugal force applied to laundry and moment of inertia about the center of gravity;

FIG. 7 is a graph showing differences in entanglement rates upon completion of drying between a case where an auxiliary baffle is provided and a case where no auxiliary baffle is provided;

FIG. 8 is a graph showing differences in vibration produced in the dehydration step between a case where an auxiliary baffle is provided and a case where no auxiliary baffle is provided and further between different sizes of auxiliary baffles;

FIG. 9 is a graph showing differences in the vibration amplitude when an auxiliary baffle 23 takes different values of height; and

FIG. 10 is a graph showing differences in the vibration amplitude when an auxiliary baffle 23 takes different values of axial dimension.

DESCRIPTION OF REFERENCE SYMBOLS

Reference symbol 1 designates a drum washing machine, 10 a water tub, 11 suspension (elastic supporting means), 14 a rotating tub, 15 a tub shaft, 20, 21 and 22 main baffles, 23 an auxiliary baffle, and 23a and 23b inclined faces.

BEST MODE FOR CARRYING OUT THE INVENTION

The invention will be described in more detail with reference to the accompanying drawings. FIGS. 1 to 10 illustrate one embodiment of the invention. The invention is applied to a drum washing machine of the open top type in the embodiment. Referring to FIGS. 1 and 2, a washing machine 1 in accordance with the embodiment of the invention comprises a base plate 2, an outer cabinet 3 fixed on the base plate 2 and a top cover 5 attached to an upper part of the outer cabinet 3 and having an access opening 4 through which laundry is put into and taken out of a rotating tub. The outer cabinet 3 comprises a main body 6 and a front panel 7. The top cover 5 is provided with an outer lid 8 opening and closing the access opening 4. The outer lid 8 is formed into a foldable type and includes a front lid 8a and a rear lid 8b. An operation panel 9 is provided on a right front of the top cover 5.

A generally cylindrical water tub 10 is elastically supported by a plurality of suspensions 11 (corresponding to elastic supporting means) in the outer cabinet 3. Each suspension 11 comprises a damper 11a and a suspension coil spring 11b. The water tub 10 has an opening 13 formed in an upper part thereof. The opening 13 is opened and closed by an inner lid 12. When the opening 13 is closed by the inner lid 12, a

watertight seal is provided between the inner lid 12 and the opening 13.

A generally cylindrical rotating tub 14 is rotatably supported in the water tub 10. The rotating tub 14 has a diameter of about 520 mm and an axial dimension of about 400 mm. The rotating tub 14 serves as a washing tub, dehydrating tub and drying tub. The rotating tub 14 has a peripheral wall formed with a number of small holes (not shown). A pair of substantially horizontally extending tub shafts 15 (shown only in FIG. 5) are mounted on left and right end plates of the rotating tub 14 respectively. The tub shafts 15 are rotatably supported on bearings (not shown) provided on the left and right end plates of the water tub 10 respectively. The tub shafts 15 extend substantially horizontally. An electric motor (not shown) is mounted on the left end plate of the water tub 10. The motor has a rotating shaft coupled to an end of the tub shaft 15 supported by the left end plate of the water tub 10. Thus, the rotating tub 14 is directly driven by the motor. Reference symbol "O" in FIG. 2 designates a center of the tub shaft 15, namely, an axis passing through center of rotation of the rotating tub 14.

The peripheral wall of the rotating tub 14 is formed with an opening 17 (see FIG. 3) opened and closed by a drum lid 16. The drum lid 16 comprises a main plate 18 pivoting about a fulcrum 18a (FIG. 2) and an auxiliary plate 19 pivoting about a fulcrum 19a. The main and auxiliary plates 18 and 19 are linked by a link mechanism (not shown) so as to be opened and closed. When the drum lid 16 is closed (state as shown in FIG. 2), a distal

end of the main lid 18 overlaps a distal end of the auxiliary plate 19. The drum lid 16 is held in the closed state by locking means (not shown). When the rotating tub 14 is stationary, the opening 17 is opposed to the opening 13 of the water tub 10.

5 Referring to FIGS. 2 and 3, a plurality of, for example, three, main baffles 20 to 22 each of which has a generally triangular section are provided on the inner peripheral wall of the rotating tub 14. The main baffles 20 to 22 are disposed substantially at regular intervals. The two main baffles 20 and
10 21 are disposed at both sides of the opening 17 so as to sandwich the opening 17. Each of these main baffles has a length set at about 230 mm. The other main baffle 22 is disposed so as to be opposed to the opening 17 with the center of rotation of the tub
14 being located therebetween. The main baffle 22 has a length
15 set at about 320 mm. Each of the main baffles 20 to 22 has a height (radial dimension of the rotating tub 14) set at about 30 mm. The main baffles 20 to 22 are disposed near the axial middle of the inner peripheral wall so as to be spaced away from both end plates by the same distance. The longer main baffle
20 22 encloses a counterweight to balance itself with the drum lid 16 although the counterweight is not shown.

 Referring to FIGS. 2 to 4, two pairs of auxiliary baffles 23 (first and second baffles) are provided between the main baffles 20 and 21 and between the main baffles 21 and 22 on the
25 inner peripheral wall of the rotating tub 14 respectively. The auxiliary baffles 23 of each pair are disposed on the left and right ends of the inner peripheral wall of the rotating tub 14 respectively so as to be axially opposed to each other. Each

auxiliary baffle 23 is fixed to the inner peripheral wall of the rotating tub 14 by screws so as to be in contact with the left or right end plate of the tub. Each auxiliary baffle 23 generally has the shape of a triangular pyramid and is tapered from either
5 end plate of the rotating tub 14 toward the axial middle of the inner peripheral wall of the tub. Each auxiliary baffle 23 has a narrow inclined face 23a extending from either one end plate of the rotating tub 14 toward the other end plate and inclined to the inner peripheral wall side. Each auxiliary baffle 23
10 further has triangular inclined faces 23b extending from the inclined face 23a toward the inner peripheral wall of the rotating tub 14 and inclined to both peripheral sides respectively.

Reference symbol "H1" designates a height of a portion of each auxiliary baffle 23 in contact with either end plate of the rotating tub 14 (radial dimension of the rotating tub 14) as shown
15 in FIG. 4. The height H1 is set at about 65 mm. Further, reference symbol "H2" designates a length of the inner peripheral wall of the rotating tub 14. The length H2 is set at about 100 mm. The inner peripheral wall of the rotating tub 14 has an
20 opening (not shown) formed in a portion thereof located between the main baffle 22 and the auxiliary baffle 23 disposed between the baffles 21 and 22. Laundry which has entered a space between the water tub 10 and the rotating tub 14 is recovered through the opening. The opening is closed by a cover 25.

25 In the outer cabinet 3 are provided a water supply for supplying water into the water tub 10, drainage for draining water from the water tub 10, and a drier for dehumidifying and heating air in the rotating tub 14, returning hot air into the rotating

tub 14 thereby to dry laundry, although not shown. In the embodiment, of components of the drum washing machine 1, members of the vibration system include the water tub 10, rotating tub 14, electric motor, etc. applying load to the suspensions 11.

5 The members of the vibration system have a center of gravity located at an axial middle of the rotating tub 14.

The operation of the drum washing machine will now be described. An overall operation of the drum washing machine is controlled by a control microcomputer (not shown) accommodated
10 in the outer cabinet 3. When laundry is put into the rotating tub and start of operation is instructed, the control microcomputer carries out steps of a previously determined operation course. For example, when the washing operation starts with a standard operation course being set, the control
15 microcomputer carries out wash, rinse, dehydration and drying steps sequentially.

More specifically, in each of the wash and rinse steps, the control microcomputer drives the water supply so that water is supplied into the water tub 10 until a predetermined water level
20 is reached, and thereafter, the control microcomputer drives the motor so that the rotating tub 14 is rotated alternately in the normal and reverse directions at low speeds. When the motor is to be stopped, the control microcomputer controls the motor so that the opening 17 is opposed to the opening 13 of the water
25 tub 17. When the rotating tub 14 is rotated alternately in the normal and reverse directions at low speeds, laundry accommodated in the rotating tub 14 is raised with the water in the water tub 10 by the main baffles 20 to 22 and thereafter,

falls down repeatedly, whereby wash and rinse steps are carried out. In this case, since the laundry contains a sufficient amount of water and are accordingly heavy, the laundry located at both axial ends of the rotating tub 14 can be moved near the main baffles 20 to 22 by the auxiliary baffles although the auxiliary baffles 23 have a smaller action of raising the laundry than the main baffles 20 to 22. Furthermore, when the laundry is moved near the main baffles 20 to 22 by the auxiliary baffles 23, a mechanical force is applied to the laundry located at each axial end of the rotating tub 14 such that the laundry is pressed, whereupon the cleaning performance can be improved.

In the dehydration step, the control microcomputer drives the drainage so that water is drained from the water tub 10 and thereafter drives the motor so that the rotating tub 14 is rotated in one direction at a low speed of about 40 rpm. The laundry containing a large amount of water upon completion of draining are located at a lower interior of the rotating tub 14. Accordingly, when the rotating tub 14 is rotated at the low speed, the laundry is raised by the main baffles 20 to 22 and then falls down repeatedly. As a result, a certain amount of water contained in the laundry is extracted.

The control microcomputer then drives the motor so that the rotating tub 14 is rotated at a speed ranging from 60 to 80 rpm in one direction. In this case, the laundry is moved in the rotating tub 14 by the main baffles 20 to 22 and auxiliary baffles 23, sticking uniformly to an entire inner peripheral wall of the rotating tub 14. More specifically, the laundry located near an axially central interior of the rotating tub 14 is raised by

the main baffles 20 to 22. The laundry then sticks to the inner peripheral wall of the rotating tub 14 or falls down depending upon a magnitude of centrifugal force applied to the laundry.

FIG. 5 explains a centrifugal force applied to laundry S in the rotating tub 14. A centrifugal force F applied to the laundry S is defined as:

$$F=m \cdot r \cdot \omega^2 \quad (1)$$

where reference symbol "r" designates a distance from the central rotation axis O of the rotating tub 14 to the center of gravity of the laundry S, reference symbol "m" the mass of laundry S and reference symbol " ω " a turning angle velocity. The centrifugal force F is in proportion to the distance r as shown in equation (1). When a large amount of laundry S is accommodated in the rotating tub 14, a distance r1 from the center of gravity of laundry S1 located at the outer peripheral side to the central rotation axis O is larger than a distance r2 from the center of gravity of laundry S2 located at the inner peripheral side to the central rotation axis O ($r1 > r2$). Accordingly, a centrifugal force applied to the laundry S1 becomes larger than a centrifugal force applied to the laundry S2. As a result, of the laundry raised by the main baffles 20 to 22, the laundry located at the outer peripheral side sticks to the inner peripheral wall without falling down, whereas the laundry located at the inner peripheral side falls down. Consequently, the laundry in the rotating tub 14 is gradually dispersed, sticking to the inner peripheral wall.

On the other hand, water has been extracted from the laundry located at each axial end side of the rotating tub 14 such that the laundry has a light weight. Accordingly, the laundry is

raised by the auxiliary baffles 23. In this case, since each auxiliary baffle 23 has the shape of the triangular pyramid, the laundry is moved by the inclined faces 23a near the axial center of the rotating tub 14 and further moved by the inclined faces 23b from the peripheral both sides of each auxiliary baffle 23 near the axial center. Consequently, the laundry is gathered near the axial center of the rotating tub 14. The laundry gathered near the axial center of the rotating tub 14 is caused to stick uniformly to the inner peripheral surface of the rotating tub 14 by the action of the above-described main baffles 20 to 22.

Thus, the laundry in the rotating tub 14 is gradually dispersed to the entire inner peripheral wall surface such that the unbalanced condition is reduced. As the result of the foregoing operation, an amount of laundry located near the axial center of the rotating tub 14 becomes larger than an amount of laundry located near both ends of the tub.

When determining that the laundry has stuck uniformly to the inner peripheral wall of the rotating tub 14, the control microcomputer drives the motor so that the rotational speed of the rotating tub 14 is increased to about 100 rpm. This determination is made, for example, by detecting variations in the rotational speed (rotation unevenness) of the motor during one turn of the rotating tub. The rotational speed (100 rpm) is set at a rotational speed at which the centrifugal force applied to all the laundry in the tub 14 exceeds the gravitational acceleration. Accordingly, in this case, the rotating tub 14 is rotated while all the laundry has stuck to the inner peripheral

wall of the rotating tub 14.

Subsequently, the control microcomputer drives the motor so that the rotational speed of the tub 14 is increased to a maximum speed ranging from 900 to 1200 rpm. As a result, the laundry sticking to the inner peripheral wall of the rotating tub 14 is rotated together with the rotating tub 14, whereby the laundry is centrifugally dehydrated. When large vibrations are produced at a plurality of resonance points appearing during the increase in the rotational speed of the tub 14 from 100 rpm to the maximum speed, the control microcomputer decreases the rotational speed of the tub 14 so that the laundry in the tub 14 is moved, so that an operation is carried out to correct the unbalanced condition resulting in the resonant vibration. After correction of the unbalanced condition, the control microcomputer again increases the rotational speed of the rotating tub 14 up to the maximum speed.

FIG. 5 explains vibration produced during dehydration. The magnitude of the vibration produced during dehydration depends upon an exciting force. The magnitude of the exciting force depends upon a centrifugal force applied to the laundry S and moment of inertia M about the center of gravity acting upon the laundry S. The moment of inertia M is defined as:

$$M=F \cdot L=m \cdot r \cdot \omega^2 \cdot L \quad (2)$$

where reference symbol "G" designates a plane which passes the center of gravity of the vibration system and is perpendicular to the central rotation axis O, and reference symbol "L" designates a distance from the plane G to the center of gravity of the laundry S. Reference symbol "F" designates the

centrifugal force acting upon the laundry as described above. As shown by equation (2), the moment of inertia M is in proportion to the distance r and distance L . Further, the centrifugal force F is in proportion to the distance r as described above.

5 Accordingly, the vibration due to the unbalanced condition near the axial center of the rotating tub 14 becomes smaller than the vibration due to the unbalanced condition at each of both axial ends in the rotating tub 14.

Since the laundry is gathered near the axial center of the
10 rotating tub 14 in the embodiment, the unbalanced condition exists near the axial center in the interior of the rotating tub 14, namely, near the center of gravity of the vibration system. Consequently, vibration produced in the dehydration step can be reduced as compared with the conventional drum washing machine
15 in which the unbalanced condition occurs at each of axial ends of the rotating tub.

In the drying step, the control microcomputer drives the motor so that the rotating tub 14 is rotated alternately in the normal and reverse directions at low speeds and drives the drier.
20 As a result, hot air is supplied into the rotating tub 14 so that moisture contained in the laundry is extracted. Air containing moisture is dehumidified and heated and thereafter, again returned into the rotating tub 14. The laundry in the rotating tub 14 is dried by the aforementioned air circulation.

25 Furthermore, when the rotating tub 14 is rotated alternately in the normal and reverse directions at low speeds, the laundry in the tub is raised by the main baffles 20 to 22 and then caused to fall down by the hot air flowing in the tub

while spreading. Further, the auxiliary baffles 23 moves the laundry fallen in the spread state near the axial center of the rotating tub 14. In other words, the laundry is caused to move in the rotating tub 14 while being dispersed and gathered. Consequently, since the laundry is efficiently brought into contact with the hot air flowing in the rotating tub 14, the drying efficiency can be improved.

An experiment conducted by the inventors shows that when laundry is agitated by the main baffles 20 to 22 and auxiliary baffles 23, twisting and entanglement of laundry can be reduced upon completion of the drying step.

FIG. 7 is a bar graph showing comparison of entanglement rates at the time of completion of the drying step between the drum washing machine (P in FIG. 7) having the main baffles 20 to 22 and auxiliary baffles 23 and a drum washing machine (Q in FIG. 7) having only the main baffles 20 to 22. The Axis of abscissas represents an amount of laundry and the axis of ordinates represents an entanglement rate. The entanglement rate T (%) is obtained from the following equation:

$$T = \{(T_1 - T_0) / T_0\} \times 100$$

where T₀ and T₁ are averages of time periods in sec. required for taking all the laundry comprised of a plurality of pieces of bleached cotton cloth out of the rotating tub 14 before and after a washing operation one by one to the rhythm with a metronome respectively. As obvious from FIG. 7, an entanglement rate is lower in the drum washing machine with the auxiliary baffles 23 than in a washing machine without auxiliary baffles 23.

The following effects can be achieved from the foregoing

embodiment. Since the rotating tub 14 is provided with the auxiliary baffles 23, laundry can be moved near the axial center in the rotating tub 14 during the dehydration step, namely, near the center of gravity of the vibration system. Consequently, occurrence of vibration and noise can be restrained in the dehydration step. Further, since the laundry located at both axial ends of the tub 14 is efficiently moved near the axial center by the auxiliary baffles 23, an operating time for correction of unbalanced condition can be shortened.

10 In the drying step, laundry is moved in the rotating tub 14 while being dispersed and gathered by cooperation of the main baffles 20 to 22 and the auxiliary baffles 23. Particularly in the foregoing embodiment, since the main baffles 20 to 22 and the auxiliary baffles 23 are spaced from each other, these baffles efficiently cooperate to move the laundry. Consequently, the drying efficiency can be improved and the entanglement of laundry can be reduced. Further, the experiment conducted by the inventors shows that an amount of wrinkle produced on the laundry at the time of completion of the drying is smaller in the drum washing machine with the auxiliary baffles 23 than in the drum washing machine without auxiliary baffles. This results from the reduced entanglement rate in the drying step. Accordingly, the laundry can be finished in a more favorable condition.

25 FIG. 8 shows the results of an experiment conducted by the inventors regarding differences in amplitude of vibration produced during dehydration depending upon provision or non-provision of the auxiliary baffles 23 and the sizes of the tub. In FIG. 8, the axis of abscissas represents an amount of

laundry (kg) and the axis of ordinates represents amplitude of vibration (mm). Further, in FIG. 8, polygonal lines P1 to P4 represent the drum washing machine with the main baffles 20 to 22 and auxiliary baffles 23, and polygonal line Q represents a drum washing machine with only the main baffles 20 to 22. (60mm, 40 mm), (60 mm, 65 mm), (100 mm, 40 mm) and (100 mm, 65 mm) are combinations of the lengths (H1, H2; and see FIG. 4) of auxiliary baffles of the drum washing machine corresponding to the polygonal lines P1 to P4.

As obvious from FIG. 8, the amplitude of vibration produced during dehydration is smaller in the drum washing machine with the main baffles 20 to 22 and auxiliary baffles 23 than in the drum washing machine with only the main baffles 20 to 22. Furthermore, of the drum washing machines with auxiliary baffles 23, the drum washing machine as represented by the polygonal line P4, namely, the drum washing machine of the embodiment has the smallest amplitude. Consequently, the vibration produced during dehydration can be reduced to a large extent.

The invention should not be limited by the foregoing embodiment but may be modified as follows. The height (H1) and the length (H2) of each auxiliary baffle 23 should not be limited by the above-described dimensions. FIGS. 9 and 10 are graphs made on the basis of the experimental results of FIG. 8 in order that differences in the vibration amplitude due to the differences in the height and the length of each auxiliary baffle 23 may be investigated. More specifically, the graph of FIG. 9 is made on the basis of the experimental results (corresponding to polygonal lines P1 and P2 in FIG. 8) regarding the drum washing

machine with the auxiliary baffles 23 having the same length (60 mm) and different heights. The Axis of abscissas in FIG. 9 represents the height of each auxiliary baffle 23 in mm and the axis of ordinates represents a reduced amount of amplitude in the drum washing machine without auxiliary baffles. Further, the graph of FIG. 10 is made on the basis of the experimental results (corresponding to polygonal lines P1 and P3 in FIG. 8) regarding the drum washing machine with the auxiliary baffles 23 having the same height (40 mm) and different lengths. The Axis of abscissas in FIG. 10 represents the length of each auxiliary baffle 23 in mm and the axis of ordinates represents a reduced amount of amplitude in the drum washing machine without auxiliary baffles in mm. Further, polygonal lines K1 to K4 in FIGS. 9 and 10 are made on the basis of data in the cases where an amount of laundry is 1 kg, 3 kg, 5 kg and 8 kg.

As obvious from FIGS. 9 and 10, the reduced amount of vibration is increased as the height of each baffle 23 becomes larger or as the length of each baffle 23 becomes larger. In consideration of the variations of about 0.5 mm in the amplitude of vibration produced during the dehydration step, the vibration reduction effect becomes significant when a reduced amount of vibration exceeds 0.5 mm. Accordingly, regarding four amounts of laundry used in the experiment, each auxiliary baffle for which a reduced amount of vibration exceeds 0.5 mm has the height of not less than about 30 mm and the length of not less than about 50 mm.

The height of each auxiliary baffle affects its action of raising laundry and has a relation with a thickness of the laundry.

Since a general thickness of laundry is about 30 mm, it is preferable to set the height of each auxiliary baffle at 30 mm or above. The length of each baffle affects its action of moving laundry from the axial ends of the rotating tub near the center of gravity of the vibration system. The length of each baffle also has a relation with an axial dimension of the rotating tub and a distance from an end of the rotating tub to the center of gravity of the vibration system. In the foregoing embodiment, the axial dimension of the rotating tub 14 is 400 mm and the distance from the end plate of the rotating tub 14 to the center of gravity is 200 mm. Accordingly, the length of each auxiliary baffle from which a significant vibration reduction can be achieved is not less than one eighth of the length of the rotating tub 14 and not less than a quarter of the distance from the end plate to the center of gravity. In this case, the auxiliary baffles 23 need to be disposed in a region of the inner peripheral wall surface of the rotating tub 14 from the plane G (see FIG. 5).

Further, the auxiliary baffles disposed at both axial sides of the rotating tub may or may not be opposed to each other. Further, the auxiliary baffles may be provided on the inner peripheral wall so as to be located close to the end plate of the rotating tub but need not be in contact with the end plate.

In a drum washing machine with the central rotation axis of the rotating tub is inclined forwardly upward, auxiliary baffles located close to the front end plate may be provided on the front of the inner peripheral wall of the rotating tub in order that the laundry in the rotating tub may be one-sided to

the inner or rear interior of the rotating tub.

In a drum washing machine in which the center of gravity of the vibration system is shifted from the axial center of the rotating tub, it is preferred that a pair of auxiliary baffles axially opposed to each other have different axial dimensions respectively. More specifically, when the center of gravity is one-sided to one side relative to the axial center of the rotating tub, the auxiliary baffle disposed at an axial one side of the peripheral wall should have a smaller axial dimension than the auxiliary baffle disposed at the other side of the peripheral wall. However, each auxiliary baffle needs to be disposed in the region between the plane G passing the center of gravity and the end plate.

Each baffle may be made by pressing the peripheral wall or the end plate. In this case, since the auxiliary baffles may be formed integrally with the rotating tub, the number of assembly steps can be reduced. Furthermore, each auxiliary baffle should not be limited to the shape of triangular pyramid but may be formed into the shape of a semicircular pyramid.

The invention may be a drum washing machine having an access opening in the front. In this case, auxiliary baffles may be provided on a front part of the peripheral wall of the rotating tub so as to be located close to the front end plate of the rotating tub. The rotating tub with an opening in the front is rotated about a rotational shaft provided on the rear thereof. Accordingly, when laundry gathers to the front interior in the rotating tub, the vibration caused by the rotating tub is increased and a large moment is applied to the rotational shaft

or a shaft bearing. However, when the auxiliary baffles are provided on the front part of the peripheral wall of the rotating tub, the laundry can be prevented from gathering to the front interior of the rotating tub and accordingly, an occurrence of
5 vibration can be suppressed.

APPLICABILITY OF INDUSTRIAL USE

As obvious from the foregoing, since the drum washing machine of the present invention can suppress occurrence of vibration, the drum washing machine is useful as a household
10 washing machine used in a quiet environment.